

General Problem Solving

- All the problem solving methods that we have seen are all purpose
- Their basis is an heuristic function that orders the solution paths to explore in order to reach faster the goal
- Expressiveness of heuristic functions is limited
- Only a function can not represent all possible decision during the search of a solution
- The reduction of computational time is limited
- More specific knowledge about the problem allows to make better decisions

Knowledge Based Systems

- We are looking for systems that allow a better use of the domain knowledge
- This knowledge allows to analyze better each step of the resolution process
- These systems can simulate the way an expert solves a problem
- The knowledge of the domain has to be thoroughly formalized
- This knowledge has to be integrated in the solving problem process

From the Expert Systems to the KBS

Expert Systems

- The goal is to simulate the solving problem process of human experts
- Their development is based on traditional knowledge engineering techniques
- Mainly implemented with rule production systems
- Closed applications that usually do not use machine learning

Knowledge Based Systems

- The goal is to use domain knowledge to solve problems
- Automatic knowledge acquisition is a part of the knowledge engineering process
- Heterogeneous methodologies and techniques (rules, cases, qualitative models, intelligent agents, emergent computation, ...)
- Adaptive systems with machine learning capabilities

Characteristics of KBS

- KBS are used in complex problems where conventional software applications are not enough
- The nature of these problems requires some specific characteristics
 - Flexibility and capability to be applied to different kinds of problems
 - Emulation of rational thinking as problem solving mechanism
 - To be able to manage in a rich environment with a great quantity of information
 - To be able to use symbolic information during the reasoning process
 - Use of natural interfaces as a mean of communication with the user
 - Use of machine learning as method of adaptation

Characteristics of KBS

When building systems with these characteristics:

- Domain knowledge and problem solving knowledge has to be independent of the mechanism that controls the resolution of the problem
- Heuristic knowledge has to be incorporated in the resolution process (incomplete, approximate, non systematic).
- A tight interaction with the user/environment/other systems has to be allowed

Research areas involved in KBS

The contribution of many artificial intelligence areas are needed to give to KBS the mentioned characteristics and abilities, among them:

- Knowledge representation (domain knowledge, problem solving knowledge, heuristics, ...)
- Reasoning and inference (Predicate calculus, default reasoning, uncertainty, time, ...)
- Heuristic search/problem solving
- Natural language processing (interfaces)
- Machine learning (automatic domain knowledge acquisition, adaptation, ...)

Necessity of KBS

- To have systems that make available the knowledge of highly qualified experts
- To help/train experts/non experts
- To preserve expert knowledge
- To obtain quickly solutions supported by explanations
- To process great volumes of information
- To have systems that can make decisions autonomously

When problems need KBS to be solved?

- The problem is complex enough to justify the development costs
- We have a correct assessment of the size of the problem
- We have available expert knowledge in order to solve the problem
- The problem can be described as a reasoning process
- It is possible to adequately structure the knowledge and the solving process
- Can not be solved by means of traditional techniques
- We have available cooperative experts

Problems of the KBS

- Brittleness
- The reasoning process is hard to control
- Low reusability of the knowledge and problem solving strategies
- Sometimes it is difficult to integrate machine learning techniques in the system
- To acquire knowledge from the experts is an expensive and hard task
- To validate the soundness and completeness of the system is difficult

Areas of problems that use KBS

- All kinds of problems that use specialized expert knowledge
- Applied to uncountable domains (medicine, engineering, weather forecasting, banking, ...)
- Problems that involve analyzing evidences (interpretation, diagnostics, supervision, prediction, ...)
- Problems that involve building a solution (design, planning, configuration, ...)